NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

MULCHING

(Acre)

CODE 484

DEFINITION

Applying plant residues or other suitable materials produced off site, to the land surface.

PURPOSE

- Conserve soil moisture
- Reduce energy use associated with irrigation
- Moderate soil temperature
- Provide erosion control
- Suppress weed growth
- Facilitate the establishment of vegetative cover
- Improve soil quality
- Reduce airborne particulates

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all lands where mulches are needed. This practice may be used alone or in combination with other practices.

CRITERIA

General Criteria Applicable to All Purposes

The selection of mulching materials will depend primarily on site conditions and the material's availability. Mulch materials shall consist of natural and/or manufactured materials that are environmentally safe such as plant residue, wood bark or chips, gravel, biodegradable plastic, fabric, rice hulls, or other equivalent materials of sufficient dimension (depth or thickness) and durability to achieve the intended purpose for the required time period. Refer to the Appendix, Table 1 for information on common natural mulches and Table 2 for information on manufactured mulch materials.

Prior to mulching, the soil surface shall be prepared in order to achieve the desired purpose.

The mulch material shall be evenly applied and, if necessary, anchored to the soil. Tackifiers, binders, pinning, netting, crimping or other acceptable methods of anchoring will be used if needed to hold the mulch in place for specified periods.

As a minimum, manufactured mulches shall be applied according to the manufacturer's specifications.

Hydroseeding and hydromulching will be performed in two separate operations. The hydroseeding operation will be the first application and will include the seed, inoculants, wood fiber mulch not to exceed 500 pounds per acre, and tackifier. The hydromulching operation will be the second treatment with the remaining wood fiber mulch and tackifier.

The proper *Rhizobium* inoculants will be included in any hydroseeding operation that includes legume seed. The inoculants will be applied at three times the recommended rate. Slurry that contains inoculants will be applied within one hour or re-inoculated.

Mulching operations shall comply with federal, state and/or local laws and regulations during the installation, operation and maintenance of this practice.

Mulch material shall be relatively free of disease, pesticides, chemicals, noxious weed seeds, and other pests and pathogens. Do not use mulches with a sour smell like vinegar, ammonia, or some silage.

Additional Criteria to Conserve Soil Moisture

Mulch materials applied to the soil surface shall provide at least 60 percent surface cover to reduce potential evaporation.

Additional Criteria to Moderate Soil Temperature

Mulch materials shall be selected and applied to obtain 100 percent coverage over the area treated. The material shall be of a significant thickness to persist for the period required for the temperature modification.

Additional Criteria to Provide Erosion Control

When mulching with cereal grain straw or grass hay, apply at a rate to achieve a minimum 70 percent ground cover. Mulch rate shall be determined using current erosion prediction technology to reach the soil erosion objective.

When mulching with wood products such as wood chips, bark, or shavings or other wood materials, apply a minimum 2-inch thickness.

When mulching with gravel or other inorganic material apply a minimum 2 inch thickness and shall consist of pieces 0.25 to 1.50 inches in diameter.

Additional Criteria to Suppress Weed Growth

The thickness of mulch will be determined by the size of the plant being mulched. Mulches shall be kept clear of the stems of plants where disease is likely to occur. Mulches applied around growing plants or prior to weed seedling development shall have 100 percent ground cover. Thickness of the mulch shall be adequate to prevent emergence of targeted weeds. Plastic mulches may be used.

Additional Criteria to Establish Vegetative Cover

Mulch shall be applied at a rate that achieves a minimum of 70 percent ground cover to provide protection from erosion and runoff and yet allow adequate light and air penetration to the seedbed to ensure proper germination and emergence.

Additional Criteria to Improve Soil Quality

Apply mulch materials with a carbon to nitrogen ratio (C:N) less than 30 to 1 so that soil nitrogen is not immobilized by soil biota. Do not apply mulch with C:N less than 20:1 to an area of designed flow in watercourses.

Use the Soil Conditioning Index (SCI) to assess soil quality impacts and to determine the type and rate of the mulching material.

Additional Criteria to Reduce Airborne Particulate Matter from Wind Erosion

Mulch rate shall be determined using current wind erosion prediction technology to achieve the desired soil erosion (movement of particulates offsite) objective.

CONSIDERATIONS

Evaluate the effects of mulching on evaporation, infiltration and runoff. Mulch material may affect microbial activity in the soil surface, increase infiltration, and decrease runoff, erosion and evaporation. The temperature of the surface runoff may also be lowered.

Mulch material used to conserve soil moisture should be applied prior to moisture loss. Prior to mulching, ensure soil under shallow rooted crops is moist, as these crops require a constant supply of moisture.

Mulch materials with a high water holding capacity and/or high impermeability to water droplets may adversely affect the water needs of plants.

Fine textured mulches (e.g. rice hulls) which allow less oxygen penetration than coarser materials should be no thicker than 1 or 2 inches.

Organic materials with C:N ratios of less than 20:1 will release nitrate-nitrogen which could cause water quality impairments.

Mulching may also provide habitat for beneficial insect and provide pest suppression.

Clear and infra-red transmissible (IRT) plastics have the greatest warming potential. They are transparent to incoming radiation and trap the longer wavelengths radiating from the soil. Black mulches are limited to warming soils by conduction only and are less effective.

Clear mulches allow profuse weed growth and may negate the benefits of soil warming. Black mulches provide effective weed control. Wavelength selective (IRT) plastic provides the

soil warming characteristics of clear mulch with the weed control ability of black mulch.

Low permeability mulches (e.g. plastic) may increase concentrated flow and erosion on un-mulched areas.

Consider potential toxic alleleopathic effects that mulch material may have on other organisms. Animal and plant pest species may be incompatible with the site.

Consider the potential for increased pathogenic activity within the applied mulch material.

Keep mulch 3 to 6 inches away from plant stems and crowns to prevent disease and pest problems. Additional weed control may be needed around the plant base area.

Deep mulch provides nesting habitat for ground-burrowing rodents that can chew extensively on tree trunks and/or tree roots. Light mulch applied after the first cold weather may prevent rodents from nesting.

Some mulch material may adversely affect aquatic environments through changes in water chemistry or as waterborne debris. Consider placing mulch in locations that minimizes these risks.

Consider potential effects of soil physical and chemical properties. Refer to soil survey data as a planning tool for assessment of sites. Consult Web Soil Survey to obtain soil information.

PLANS AND SPECIFICATIONS

Specifications shall be prepared for each site and purpose and recorded using approved specification sheets, job sheets, technical notes, narrative statements in the conservation plan, or other acceptable documentation.

Documentation shall include:

- Purpose of the Mulch
- Type of mulch material used
- The percent cover and/or thickness of mulch material
- Timing of application
- Site preparation
- Listing of netting, tackifiers, or method of anchoring, and
- Operation and maintenance.

OPERATION AND MAINTENANCE

Mulched areas will be periodically inspected, and mulch shall be reinstalled or repaired as needed to accomplish the intended purpose.

Evaluate the effectiveness of the mulch (application, amount of cover provided, durability, etc.) and adjust management decisions or type of mulch to better meet the intended purposes.

Removal or incorporation of mulch materials shall be consistent with the intended purpose and site conditions.

Operation of equipment near and on the site shall not compromise the intended purpose of the mulch.

Prevent or repair any fire damage to the mulch material.

Properly collect and dispose of artificial mulch material after intended use.

Monitor and control undesirable weeds in mulched areas.

REFERENCES

Agriculture and Agri-Food Canada. 2000. Plastic mulches for commercial vegetable production. Canada-Saskatchewan Irrigation Diversification Centre. Outlook, Saskatchewan.

Renard, K.G., G.R. Foster, G.A. Weesies, D.K. McCool, and D.C. Yoder, Coordinators. 1997. Predicting soil erosion by water: A guide to conservation planning with the Revised Universal Soil Loss Equation (RUSLE). U.S. Department of Agriculture, Agriculture Handbook No. 703.

Shaffer, M.J., and W.E. Larson (ed.). 1987. NTRM, a soil-crop simulation model for nitrogen, tillage and crop residue management. USDA Conserv. Res. Rep. 34-1. USDA-ARS.

Toy, T.J., and G.R. Foster. (Ed.) 1998. Guidelines for the use of the Revised Universal Soil Loss Equation (RUSLE) Version 1.06 on mined lands, construction sites, and reclaimed lands. USDI, OSMR.

USDA, NRCS. 2002. National Agronomy Manual. 190-V. Washington, D.C.

APPENDIX

Table 1 – Guide to Natural Mulch Materials, Rates, and Uses

Natural Mulch Materials	Quality Standard	Application Rates (minimum) per		Depth Applied	Comments
		1000 ft^2	Acre		
Sawdust (aged or composted), Rice Hulls, and Ground Corn Cobs	Free from weeds, trash and coarse materials	200-300 ft^3	----------	1 to 4 inches	Effective mulch around ornamentals, small fruits, and other nursery stock. Special application rates – fruit trees 3"- 4", blueberries 4", vegetables and flowers 1"- 2". Resistant to wind blowing. Requires 30 to 35 lbs. of N per ton to prevent N deficiency from mulch. Recommended rate based on 1 ft^3 weighing 24 lbs. Fluff and renew mulch each spring.
Wood Chips, Bark or Shavings (chunks, shredded or granules)	Green or air-dry. Free of weed seeds, trash, and coarse materials	470-920 lbs.	10-20 tons	2 to 4 inches	Same use and application as sawdust but requires less N per ton (20-25 lbs.). Resistant to wind blowing. Decomposes slowly. Do not use mulch with a sour smell (odor of vinegar, ammonia, silage, etc.)
Wood Excelsior	Green or air-dried burred wood fibers	90 lbs. (1 bale)	2 tons	--------	Effective for erosion control. Tie-down usually not required but may be subject to some wind blowing. Packaged in 80 to 90 lbs. bales. Decomposes slowly.
Compost	Free of weed seeds, trash and coarse materials	360-460 lbs.	8-10 tons	--------	Excellent moisture conservation. Some resistance to wind blowing. Produce using an aerobic process with adequate time and temperature to kill weed seeds, pathogens, and insect larvae.
Cornstalks (shredded or chopped)	Air-dry, shred into 8-12 inch lengths	180-280 lbs.	4-6 tons	--------	Effective erosion control, relatively slow to decompose. Excellent mulch for crop fields. Some value as a cover crop. Resistant to wind blowing.
Gravel, Crushed Stone, or Slag	Washed, size ¼ to 1½ inches	9 yd^3	--------	2 inches thick	Excellent mulch for short slopes and around woody plants or ornamentals. Use ¼ - ½ inch size where subject to foot traffic (approx. 2500 lbs/yd^3). Avoid crushed limestone.
Straw, Grass Hay, Alfalfa Hay	Air-dry. Free of mold, weed seeds, and coarse materials	70-115 lbs. or 1½ -2½ 50 lbs. bales	1½ -2½ tons or 60-100 50 lbs. bales	Cover surface 75-90%; 1½" -2½" thick	Use heavier rates if benefits are desired more than 3 months. Subject to wind blowing unless kept moist and tied down. Most common, widely used mulch materials. Good for erosion control. Avoid use of material with visible weeds.
Pine Straw (needles)	Air-dry, clean bales, free of coarse materials	200-300 lbs. (10 bales)	--------	3-4 inches	Acidifying mulch product, good for acid-loving plants, Decomposes slowly and resists compaction.
Peat Moss	Dried, compressed, free of coarse materials	200-400 ft^3	--------	2-4 inches	Most affective as a mulch around ornamentals. Subject to wind blowing unless kept wet. Packages in 100 lbs. bales (6 ft^3). Excellent moisture holding capacity.

Table 2 – Guide to Manufactured Mulch Materials, Rates, and Uses

Manufactured Mulch Material	Quality Standard	Application Rates (minimum) per		Depth Applied	Comments
		1000ft^2	Acre		
Paper Mat - Twisted Kraft Paper Yarn	Plain weave – warp 7 and weft 4 per inch. Selvage edge with polypropy-lene filaments.	--------	--------	1 layer thick	Use over bare soil to hold seed in place and aid in germination without mulch. Tie down with staples according to manufacturer's specifications. Minimum weight of mat 0.125 lbs/yd^2. Roll sizes from 45 to 60 inches by 250 yards weighing 40 to 55 lbs.
Jute Mat	Undyed, unbleached plain weave. Warp 78 ends per yard; weft 41 ends per yard	--------	--------	1 layer thick	Use without additional mulch. Tie down according to manufacturer's specifications. Effective erosion control for critical areas. Rolls are often 48 inches by 50 or 75 yards.
Excelsior or Fiber Blanket	80% of fibers 6 inches or longer in length evenly distributed over entire area of blanket with a consistent thickness.	--------	--------	1 layer thick	Use without additional mulch. Tie down according to manufacturer's specifications. Top side of the blanket may be twisted Kraft paper mat or extruded biodegradable plastic mesh. Minimum roll width is 4 feet; rolls come in various lengths. Rolls must be packaged to protect against bio0degradation prior to use.
Straw Mat	Clean straw and coconut fibers. Paper products will not be permitted.	--------	--------	1 layer thick	Use without additional mulch. Tie down according to manufacturer's specification. Mat will be machine produced of straw and coconut fibers. Top side covered with photodegradable and biodegradable plastic mesh adhered to straw using biodegradable thread.
Plastic Film	Thickness 2 to 4 mils	--------	--------	1 layer thick	Use black for weed control and clear for seeding establishment without organic mulch. Remove plastic after seeding is established. Effective moisture conservation and weed control for small fruits. Large areas should have holes punched to let rainfall percolate. Must anchor to protect against wind and water damage.
Geotextle Fabric	Thickness 14 mils (minimum) – woven or non-woven polyester or polypropylene fabric	--------	--------	1 layer thick	Fabric mulch for water conservation will be black and/or capable of preventing underlying plant growth. Used as landscaping fabric with tree establishment. Mulch material will repel water for 3 to 4 weeks due to chemical surfactant on material. Anchor edges of fabric and occasionally in center with soil, stones, or staples.

Table 3 – Hydraulic Mulching Materials

Mulch Material	Slope Limitations	How to Apply
Wood Fiber (no paper mulch)	Up to and including 6:1 slopes, apply 2000 lbs./acre. Up to and including 3:1 slopes, apply 4000 lbs./acre.	Made from wood chips and shavings. Apply with a hydraulic mulching machine. Include a suitable tackifier or binder to the slurry at a minimum rate of 5% of the weight of the mulch materials. Application rate is 2000 pounds per acre on flatter slopes – double the application rate for steeper slopes.
Bonded Fiber Matrix (BFM)	Up to and including 2:1 slopes	Strands of elongated wood fibers and a bonding agent (tackifier). Requires 24 hours to dry before precipitation for effective erosion control. Longevity is 3 to 12 months. Superior erosion control protection with application rate of 4000 lbs./acre.
Mechanically Bonded Fiber Matrix (MBFM)	Up to and including 2:1 slopes	Strands of elongated wood fibers and synthetic fibers creating an interlocking matrix. Includes a bonding agent (tackifier). Provides immediate erosion protection. Longevity may exceed 12 months. Superior erosion protection with application rate of 4000 lbs./acre.

Table 4 – Mulch Anchoring Guide

Anchoring Method/ Material	Kind of Mulch to be Anchored	How to Apply
Manual Methods		
Peg and Twine	Straw, Grass Hay	After spreading mulch, divide areas into blocks approx. 1 yd^2 in size. Drive 4 to 6 pegs per block to within 2 to 3 inches of soil surface. Secure mulch to surface by stretching twine between pegs in a crisscross pattern on each block. Secure twine to each peg with 2 or more turns. Drive pegs flush with soil surface when mowing or other maintenance is planned.
Mulch Netting	Straw, Grass Hay, Wood Shavings	Staple or pin paper, jute, or plastic nettings to soil surface according to manufacturer's specifications.
Soil and Stones	Plastic or Geotextile Fabric	Plow a single furrow along the edge of area to be covered; fold about 6 inches of material into the furrow and plow furrow-slice back over plastic. Use stones or a shovel full of soil to hold material down in other places as needed.
Slit	Straw, Grass Hay	Cut mulch into soil surface with square-edge spade. Make cuts in contour rows 18 inches apart.
Mechanical Methods		
Wood Fiber with tackifier	Straw, Grass Hay, Alfalfa Hay	Apply manufactured product overtop of mulch with hydraulic mulching equipment immediately after primary mulch has been applied. Use 1000 lbs. of wood fiber per acre with 10% tackifier based on weight of wood fiber mulch.
Mulch Anchoring Tool or Coulter (smooth or notched)	Straw, Grass Hay, Alfalfa Hay	Apply uniform layer of mulch and pull mulch anchoring tool over area. Use a disk or coulter sent in a straight position to the direction the tool is pulled. Mulch material shall be "tucked" or "hair-pinned" into the soil surface to a depth of 2 inches. Anchoring tool will not move soil as a tillage operation would.
Mulch Tackifiers and Binders (water dispersible)	Straw, Grass Hay, Wood Chips or Shavings	Select a quality tackifier or binder and apply with suitable spray equipment over a uniform layer of mulch. Follow the manufacturer's recommendation for application rates and use of this product.